

## FAUNA OF FOUR SQUARE FEET OF JUNGLE DEBRIS

### I.

For a week I had been studying the bird-life of a single tree, a Canella do Matto, as I have described in detail in the preceding number of ZOOLOGICA. On the last day as I was about to go, I concentrated my attention on the tree and the surrounding jungle, endeavoring to fix it indelibly in my mind. I realized that in a few minutes I would leave this place with which I had become so intimate, and should very probably never return. I had demonstrated a remarkable concentration of bird-life when attracted by the ripened fruit of a single jungle tree. It was the unparalleled insurgence of such a variety of organisms as can occur only in the tropics.

Now that there remained only a brief space of time I tried to conceive of some last thing I could do to re-emphasize this important phase of tropical life.

As I walked slowly up the trail toward the tree I heard a rustling among the leaves at one side, and in deep shadow beyond a dense clump of scarlet heliconias, I made out a tyrant antwren (*Cercomacra tyrannina*) scratching with all its might. To the kicking power of its small legs it occasionally added sudden flicks with the bill, given with such nice judgment and power, that it flung leaves larger than itself into the air and backward quite over its body. I had often wondered of what the food of these birds really consisted. Anyone could glance at the contents of a crop and gizzard and label it "small insects." But the actual details of this varied bill of fare, except in the case of very recently swallowed objects, was usually merged and lost in the comminuted mass of legs, elytra and antennae.

Acting on this hint I brought from my camping stores an empty war bag, and carefully scraped together a few handfuls of leaves, sticks, moss, earth and mold of all sorts. From directly under the *Canella do Matto*, I gathered four square feet of jungle debris, filled my bag and shouldered it. Then I said adieu to my trail and my tree, a sorrowful leave taking as is always my misfortune. For the bonds which bind me to a place or a person are not easily broken.

In this case, however, the bond was not altogether severed, and a week later when the sky line was unbroken by land, when a long ground swell waved but did not break the deep blue of the open sea, I unlaced my bag of jungle mold. Armed with forceps, lens and vials, I began my search. For days I had gazed upward; now my scrutiny was directed downward. With binoculars I had scanned without ceasing the myriad leaves of a great tree. Now with lens or naked eye I sought for signs of life on an infinitely smaller scale; the metropolis of a fallen leaf, the inhabitants of a dead twig. When I studied the tree-top life in the lofty jungle I was in a land of Brobdingnag; now I was verily a Gulliver in Lilliput. The cosmos in my war bag teemed with mystery as deep and as inviting as any in the jungle itself.

When I began work I knew little of what I should find. My vague thoughts visualized ants and worms, and especially I anticipated unearthing myriads of the unpleasant macuins, or *bête rouge*, whose hosts had done all in their power to make life in the jungle unhappy.

For ten days or more on the steamer trip north Mr. Hartley and I labored over the jungle debris. After two hours steady concentration our eyes rebelled and we had to desist. It seemed at times as if the four square feet had increased to forty, but the last handful was finally sifted and teased to shreds. Our method of work was to place a small pile on a newspaper spread on a table under the skylights of the smoking room, and with forceps and dissecting needle to search carefully every surface of leaf and frond and to split every twig and stem.

It was found that the safest way to capture the minute creatures which crawled or hopped about was to wet a small

brush in alcohol, touch them with the tip and float them off in the liquid in a very small vial. Thus they were uninjured and we could pick them from a mass of earth or fungus without including any of the debris itself. Usually we worked with our naked eyes, but occasionally hunted over a particularly rich field with low power dissecting lenses.

Day by day our vials increased. Scores of creatures evaded our search. Many others, of which I had captured a generous number, I allowed to escape. My lilliputian census was far from the mere aggregation of ants and worms which I had anticipated, and a review of the whole showed that hardly any great group of living creatures was unrepresented.

Two objects indicated the presence of wild mammals. First a bunch of rufous hairs which in size, color and minute structure were identical with those of the common agouti, which was very common at Utinga. I also found sign of this rodent. Man himself was represented by two wads which had dropped from my gun-shots sometime during the week. One had already begun to disintegrate, wet, half decayed and inhabited by half a dozen tiny organisms.

Five feathers were the marks of birds, also doubtless the result of my study during the week. A body feather, and two primaries from a sparrow-like bird were indeterminate, but two brilliant, green plumes came without question from the body of a calliste. Of reptiles there was a broken skull of some lizard, half disintegrated with a few of the teeth still left. There was besides the small egg-shell of a lizard which had hatched and gone forth to live its life elsewhere in the jungle. A third reptilian trace may have been his nemesis—a good-sized shred of snake-skin. The group of amphibians was present even in this small area of four square feet—a very tiny, dried, black and wholly unrecognizable little frog. Fishes were absent, although from my knees as I scraped up the debris, I could almost see a little igarapé in which dwelt scores of minnows.

As I delved deeper and examined the mold more carefully for the diminutive inhabitants, I found that this thin veneer from the floor of the jungle appeared to have several layers each with its particular fauna. The upper layer was composed of

recently fallen leaves, nuts, seeds and twigs, dry and quite fresh. As yet these showed but little change, and only the damage wrought by insects and other agencies while they were still on the trees. In this layer were small colonies of ants in hollow twigs and occasional huge solitary ones. Here lived in hiding small moths, beetles and bugs awaiting dusk to fly forth through the jungle. The lowest layer was one chiefly of matted, thready roots holding together compact masses of earthy soil, mixed with a large proportion of tiny bits of quartz. The animal life of this stratum was very meagre, occasional mites—especially red ones—and a few earth and round worms, the latter in much fewer numbers than in the middle layers.

Between the upper and the middle layers were sprouting nuts and seeds, with their blanched roots threaded downward into the rich dark mold, and the greening cotyledons curling upward toward light and warmth. Thus had the great *Canella do Matto* itself begun life. In my war bag were a score of potential forest giants doomed to a death in the salt ocean.

The middle layer, finally, was the all-important stratum. In it lived four-fifths of the small folk. This was composed of debris in full course of disintegration; leaves, sometimes partly green, usually brown or black, nuts half decayed, twigs half rotten. All still preserved their form, although some were ready to fall apart at a touch. All were soaked through, or at least damp and soggy. Often four or five leaves would be stuck together, stitched with the threads of fungi. In such a haven was always a host of living organisms.

Some of the half decayed leaves were very beautiful. Vistas of pale, bleached fungus lace trailed over the rich mahogany colored tissues, studded here and there with bits of glistening, transparent quartz. Here I had many hints of a world of life beyond the power of the unaided eye. And here too the grosser fauna scrambled, hopped or wriggled. Everywhere were tiny chrysalids and cocoons, many empty. Now and then a plaque of eggs, almost microscopic, showed veriest pin-pricks where still more minute parasites had made their escape. Contracting the field of vision to this world where leaves were fields and fungi loomed as forests, competition, the tragedies, the mystery

lessen not at all. Minute seeds mimicked small beetles in shape and in exquisite tracery of patterns; small beetles curled up and to the eye became minute seeds of beautiful design. Bits of bark simulated insects, a patch of fungus seemed a worm, and in their turn insects and worms became transmuted optically into immobile vegetation. Scores of little creatures were wholly invisible until they moved. Here and there I discovered a lifeless boulder of emerald or turquoise—the metallic cuirass of some long dead beetle.

Some of the scenes which appeared as I picked over the mold, unfolded suddenly after an upheaval of debris, were startling. When we had worked with the lens for many minutes, all relative comparisons with the surrounding world were lost. Instead of looking down from on high, a being apart, with titanic brush of bristles ready to capture the fiercest of these jungle creatures, I, like Alice in Wonderland, felt myself growing smaller, becoming an onlooker, perhaps hiding behind a tiny leaf or twig. This feeling became more and more real as we labored day after day, and it added greatly to the interest and excitement. Close by would appear, under the lens, piles of great logs and branches protruding from a heaped up bank of precious stones. Mauve, yellow, orange and cerulean hues played over the scene. Over a steep hill came a horned, ungainly creature with huge proboscis and eight legs, and shining, liver-colored body, all paunch, spotted with a sickly hue of yellow. It was studded with short, stiff bristles, and was apparently as large as a wart hog and much more ugly. It was a mite, one of the biting mites of the tropics, but under the lens a terrible monster. We put one of these on our arm to see if its bite corresponded to that of the legions of macuins which tortured us daily in the jungle. Under the lens I saw the hideous creature stop in its awkward progress and as it prepared to sink its proboscis we involuntarily flinched, so fearful a thing seemed about to happen.

In the middle layer, that of most active change, and surcharged with life, ants were abundant, together with small colonies of termites. These were the only social insects, the twigfuls consisting of from five to fifteen members. All the



other organisms were isolated, scattered here and there. Life in these lowly places, so far beneath the sunlight, is an individual thing. Flocks and swarms are unknown, and the mob has no place here. Each organism must live its life and fulfil its destiny single-handed. Even when two individuals were found together it was apparently more through accident of environment than from any gregarious instinct. In fact the same tropical law which holds good in regard to plants and the larger creatures of the sunlit world overhead applies here. I found numbers of different species, but very few collections of individuals of the same kind.

Flatworms were rather rare, but small, white ones were found now and then flowing slowly along in their characteristic manner over the surface of damp, half decayed leaves, as flatworms do the world over. Roundworms, small, white and threadlike were present in equally small numbers. Earthworms of small size, one or two inches in length, were common. They moved slowly along in orthodox angleworm fashion until something alarmed them when they instantly became a maze of twisting, snapping curves, dancing all about in a most unwormlike fashion. The head and especially the collar were brightly colored, from reddish to an intense scarlet.

Centipedes and millipedes were common, all small, in keeping with the diminutive size of the other inhabitants of this little world. The largest centipede was less than an inch in length and scurried along on eighty-four legs. Very few were dark colored. Almost all were dead white, with yellowish brown heads and jaws. The larger millipedes were slow moving in spite of their abundance of feet, but small ones of various species were very agile, and slipped in and out of fungi forests in a most disconcerting way. They were about evenly divided between the groups of Polydesmoidea, Julioidea and Gerphiloidea.

Scorpions were decidedly rare, and two small and one medium sized specimen were all we could discover. Pseudoscorpions, however, were abundant and conspicuous. I secured fifty, and could have taken three or four times as many. They would rush out excitedly when disturbed, and unlike all the other creatures of the underworld did not seek to hide. Instead,



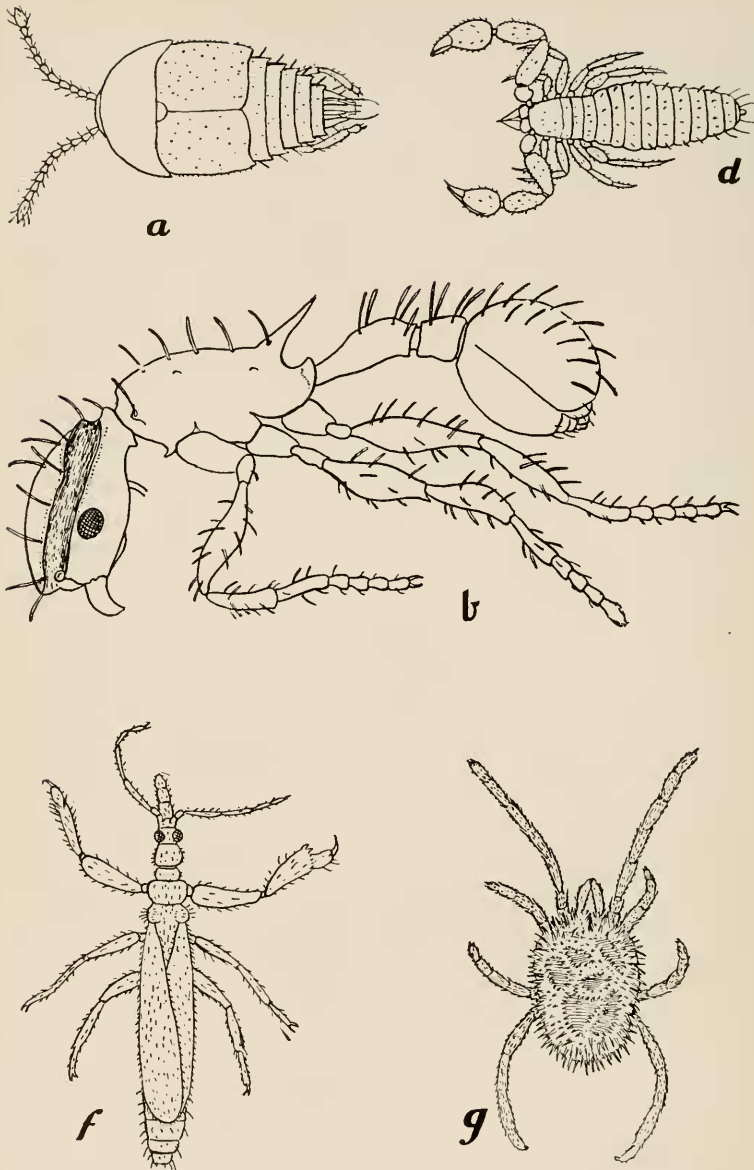


FIG. 18. REMARKABLE INSECT FORMS, CHIEFLY NEW  
 Found in the surface of a Tropical Yard of Jungle.

*a*, An unknown form, beetle, roach or cricket. *b*, The worker of a new genus and species of ant, *Blepharidatta brasiliensis* Wheeler, an extraordinary form, with small-eyed workers fitted for a subterranean life. The general structure is very simple and primitive. *d*, Pseudoscorpion, or false scorpion, a member of a compact, widely distributed family of Arachnida, with a pronounced superficial resemblance to true scorpions. *f*, Unknown, even as to order. *g*, A mite, one of the vast host of *bête rouge*, or maquins, the most troublesome pests of tropical jungles.



they bravely sought open spaces, walking slowly and feeling ahead with their great pincer-tipped arms, which they brandished with the greatest ease, although these weapons were as long as their entire bodies. When really alarmed, they scurried backward, holding up their chelae in readiness. Their bodies were whitish, but their arms and pincers deep reddish brown. While there were several species, these superficially fell into two distinct types. The most abundant kind was pot-bellied, with heavy chelae, and was slow in movement. The other had a narrow, lighter body and very delicate slender chelae, and ran with great speed when alarmed. These, however, always ran forward, not backward like the others.

Harvest men were represented by a single daddy-long-legs which looked decidedly out of place among this dense debris. I rather fancy he was strolling on the surface when my onslaught bagged him and his surroundings.

Very small and very pale colored spiders lived in the middle layer in fair numbers. We saw about two score altogether. They were usually slow or moderately gaited, like their more abundant relatives, the mites. Only twice did we see a spider dash off with any of the speed which characterized those which lived in the jungle above ground.

Next to the ants the mites and ticks were the most abundant organisms. Hardly a leaf or bit of mold was free from them. We could have gathered hundreds. They were of many species and all colors, red, brown, purple, black and flesh. Some were naked and shining, others clothed in bristly hairs to their very feet. All were repulsive, slow, and so awkward that it was inexplicable how creatures with such lack of correlation could ever manage to find food, much less a mate. They were always crawling slowly along, tumbling over every obstacle in their path. Ticks were much rarer than mites.

Numbers of very simple insects were common. Silverfish or Thysanura of several species ran like active little ghosts out of their hiding places and scurried swiftly to another which they fancied safer. Their nimble movements made them exceedingly difficult to capture. Collembolas, almost equally primitive, were usually white, but now and then a purple one appeared. Not

only were they capable of active running, but when the brush wet with alcohol was about to touch them, they leaped to a distance of twenty to thirty times their own length. Again and again this enabled them to escape. When they landed they remained motionless for some time and were most difficult to discover. Among the specimens collected were *Campoclea*, and many individuals of *Collembola*, belonging at least to three different genera *Isotoma*, *Lepidocyrtus* and *Schöttella*.

Termites, or "white ants," lived in small colonies of six to thirteen individuals in small twigs, in the upper layer of debris. Sometimes they seemed to be living in close association with real ants with no signs of hostility on either side.

A very few immature wood roaches represented the order Orthoptera, while the Hemiptera or true bugs had only a slightly better showing. Earlier stages of these insects lived in the middle layer, while those in the upper were quite adult and were ready to fly.

Beetles of small size were abundant and of numerous species. Of about fifty which I gathered, about sixty per cent were rove beetles. All the others were slow travellers, or on discovery pretended to be dead, but the rove beetles were very agile, and never lost any opportunity of trying to escape capture. There were members of *Rhynchophora* of the Tribe *Tylodini*; of the Families *Thorictidae*, *Phalacridae*, *Pselaphidae* and *Tenebrionidae*. Also of *Clivina*, *Scyclonaenus*, *Oxytelus*, and *Platystethus*; *Staphylinidae* were, as I have indicated, by far the most numerous.

Some tiny flies had apparently just emerged from their pupae in the upper layer, these being the only representatives of their order, while of the *Lepidoptera* there were only two small moths among the dry leaves of the top stratum.

Ants were the most abundant form of life, both in numbers and species. They lived in the upper layers and with the exception of the great, black, solitary fellows who apparently had been walking about on the top of the leaf stratum, all were of small size. Their colonies were apparently complete but very small, a very small twig being packed full of individuals from six to fourteen in number with a half dozen pupae.



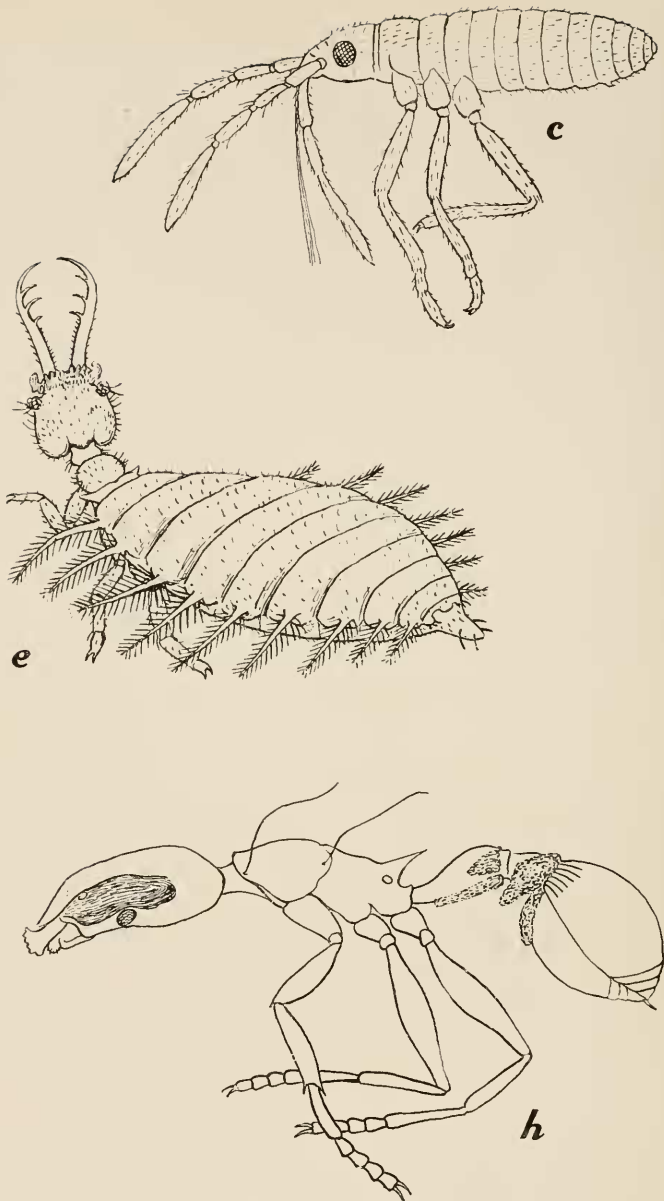


FIG. 19. REMARKABLE INSECT FORMS, CHIEFLY NEW  
 Found in the surface of a Tropical Yard of Jungle

c, Unknown form. e, An unknown form, possibly the remarkable larva of some Myrmeleonid species, related to the Ant-lions. h, The worker of a new genus and species of ant, *Glamyromyrmex bechei* Wheeler. This is also a subterranean form, living in small colonies in tiny twigs. In the colony from which the species was described, there were only three workers, three females, and two males.

Finally mollusks were found in small numbers, all very small, some with flat shells, others with steeply turreted ones. These were young specimens of two species of *Leptinaria* and several very young *Polita*, or *Vitrea* as it is more generally called.

In addition to all these was a host of unknown forms, immature or in some unrecognizable early stage of development. Some had huge jaws and the body encircled with a dense chevaux-de-frise of horny, frond-like spikes. Others were so simple that their relationships could only be guessed at.

One thing was evident early in my exploration. I was having to do with a world of small people. No insects of large size were in any layer of the debris. The largest would be very small in comparison with a May beetle. Another fact which impressed me was the durability of chitin. The remains of beetles, considering the rareness of living ones, was remarkable. The hard wing cases, the thorax armor, the segments of wasps, eyeless head masks, all these still remained perfect in shape and vivid in color. Even in the deepest layers where all else had disintegrated and returned to the elements these shards of death were as new.

Day after day as I worked with my face close to the mold, I was constantly aware of the keen, strong, pungent odor. It hinted of the age-old dissolution, century after century, which had been going on. Leaves had fallen, not in a sudden autumnal down-pour, but in a never ending drift, day after day, month after month. With a daily rain for moisture, with a temperature of three figures for the quicker increase of bacteria, and an excess of humidity to foster quick decay, the jungle floor was indeed a laboratory of vital work—where only analytic chemistry was allowed full sway, and the mystery of synthetic life was ever handicapped and ever a mystery.

Before the vessel docked we had completed our task and had secured over *five hundred* creatures from this lesser cosmos. At least twice as many remained, but in making calculations I estimated that the mold had sheltered a thousand organisms that were plainly visible to the eye.